A Comparison of Nurse Practitioners, Physician Assistants, and Primary Care Physicians' Patterns of Practice and Quality of Care in Health Centers

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Background: Under the Affordable Care Act, the number and capacity of community health centers (HCs) is growing. Although the majority of HC care is provided by primary care physicians (PCMDs), a growing proportion is delivered by nurse practitioners (NPs) and physician assistants (PAs); yet, little is known about how these clinicians' care compares in this setting.

Objectives: To compare the quality of care and practice patterns of NPs, PAs, and PCMDs in HCs.

Research Design: Using 5 years of data (2006–2010) from the HC subsample of the National Ambulatory Medical Care Survey and multivariate regression analysis, we estimated the impact of receiving NP-delivered or PA-delivered care versus PCMD-delivered care. We used design-based and model-based inference and weighted all estimates.

Subjects: Primary analyses included 23,704 patient visits to 1139 practitioners—a sample representing approximately 30 million patient visits to HCs in the United States.

Measures: We examined 9 patient-level outcomes: 3 quality indicators, 4 service utilization measures, and 2 referral pattern measures.

Results: On 7 of the 9 outcomes studied, no statistically significant differences were detected in NP or PA care compared with PCMD care. On the remaining outcomes, visits to NPs were more likely to receive recommended smoking cessation counseling and more health education/counseling services than visits to PCMDs ($P \leq 0.05$). Visits to PAs also received more health education/counseling services than visits to PCMDs ($P \leq 0.01$; design-based model only).

Conclusions: Across the outcomes studied, results suggest that NP and PA care were largely comparable to PCMD care in HCs.

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Each year, millions of low-income Americans receive their health care at community health centers (HCs). HCs are independent, community-based nonprofit organizations located in medically underserved areas and are safety-net providers by virtue of their disproportionate share of uncompensated and publicly funded care.[1] Over the last 2 decades, these providers have grown in number and capacity.[2] This growth is expected to continue under the Affordable Care Act, which authorized $11 billion in federal funds for HC capital improvements and operations.[3]

Although most HC care is provided by primary care physicians (PCMDs) who are certified in internal medicine, general and family practice medicine, pediatrics, or obstetrics/gynecology, HCs use a mix of clinicians to fulfill their missions and have traditionally relied more on nurse practitioners (NPs) and physician assistants (PAs) than private physician offices.[4] In recent years, HCs' use of these clinicians has accelerated as their share of primary care visits has increased, whereas the share seen by PCMDs has declined.[4–6]

The NP and PA roles were created in the 1960s in response to an increased demand for primary care—especially in rural and inner city settings—and an uneven geographic distribution of PCMDs across the United States. As was originally envisioned for these new roles, most NPs and many PAs currently practice primary care in settings such as physician offices, hospital-based outpatient departments, and health clinics.[7] Although both clinicians have specialized education and extensive clinical instruction, their programs of study differ with NP curricula emphasizing health promotion, disease prevention, and health education and counseling and PA curricula resembling medical school training (eg, disease mechanisms, biomedical knowledge). Beyond differences in the organization and orientation of their education, states' approaches to their licensure and their level of autonomy also vary.[8] Merely as an example, in some states, NPs can practice without physician oversight as permitted by law. Conversely, PAs must practice as members of physician-led teams and are required to be supervised by physicians in all states although the terms and conditions

vary. Over the next decade, the US Bureau of Labor Statistics considers both of these clinician groups to be among the fastest growing health care occupations—with employment increasing 35.3% and 30.4% for NPs and PAs, respectively—and significantly outpace the physician growth rate (14.0%).[9]

A growing body of evidence has compared the quality of primary care delivered by PCMDs to care delivered by NPs and PAs and generally demonstrated equivalence in these practitioners' outcomes; however, nearly all this evidence has been based on visits conducted in physician offices and hospital-based clinics.[10–15] Extending these comparisons to HCs is important given their growth, the ongoing debate regarding the extent that NPs and PAs adequately substitute for PCMDs, and this setting's unique service delivery model, regulatory environment, and operating structure. For example, HCs receive an all-inclusive per visit Medicare payment regardless of the practitioner seen[16] compared with physician offices and hospital-based clinics, which bill at higher rates for PCMD visits than for NP or PA visits—a payment policy that would likely increase the use and expand the roles of NPs and PAs. At the same time, NPs in HCs have reported greater role independence—that is, fewer restrictions, greater likelihood of managing their own patient panels—and better relationships with facility administration and leadership than in other primary care settings, which are factors that are known to optimize NP performance.[17,18] Given predicted HC expansion, these providers' continued shift toward more NP-delivered and PA-delivered care, and HCs' distinguishing features, which could differentially influence practitioner performance, it is important to compare PCMD, NP, and PA outcomes in this setting. By comparing the quality of care and practice patterns among these clinicians in HCs, this study fills an important gap and seeks to inform stakeholders about the impact of shifting from predominantly PCMD-delivered to NP-delivered and PA-delivered care. The study protocol was reviewed and approved by The George Washington University Committee on Human Research (IRB #101446).

METHODS

We used 5 years (2006–2010) of repeated cross-sectional data from the National Ambulatory Medical Care Survey (NAMCS), a multistage probability sample survey conducted by the National Center for Health Statistics (NCHS). The "traditional" NAMCS sample includes data from patient visits to office-based physicians in the United States; beginning in 2006, the annual sample was expanded to include visits to practitioners in approximately 104 HCs. Participating HCs were drawn from a roster compiled by the Health Resources and Services Administration, which provides federal oversight and funding for the Health Center Program, and up to 3 practitioners were randomly selected to participate in the survey from a list of all physicians, NPs, PAs, and nurse midwives working in these HCs. Subsequently, each practitioner provided encounter-level data for up to 30 patient visits during a randomly assigned 1-week period. Over the 5-year study period, unweighted annual response rates ranged from 84% (2007 and 2009) to 88% (2006) (authors' analysis).

Each NAMCS visit file included 4-digit practitioner codes, associated 3-digit patient visit codes, and practitioner type identifiers, which were used to assign each patient visit to the specific practitioner who was seen, thus forming "practitioner-patient visit units." To ensure appropriate attribution of outcomes, visits to >1 practitioner (eg, PCMD+NP, PCMD+PA)—which comprised <5% of HC visits (authors' analysis)—were excluded. In addition, because the sample included a relatively small number of nurse midwives and visits to them (ie, <2% of visits[5,19]), they were also excluded from the study sample.

After making these exclusions, we pooled remaining visits across the study period and used bivariate analysis to describe the sample and the population from which the sample was drawn by practitioner type. NAMCS visit weights and adjustments for NAMCS' design were used to obtain national estimates.[20]

To test the primary hypothesis—that the quality and practice patterns of NPs and PAs were comparable to those of PCMDs—multivariate logistic and negative binomial regression analyses were used to separately estimate the impact of practitioner type on each of the outcomes of interest: 3 quality indicators, 4 service utilization measures, and 2 referral pattern measures (Table 1). The quality indicators were chosen from among nearly 2 dozen that have been previously specified to reflect agreed-upon standards of practice derived from formal recommendations and consensus statements of authoritative bodies[27–30] and subsequently tested in the scholarly literature.[21–26] After examining the frequency of eligible visits for each indicator, the most prevalent indicator was selected in each of 3 categories reflecting the scope of primary care services[31]: smoking cessation counseling (prevention and early detection), depression treatment (treatment of common acute and chronic illnesses), and statin treatment for hyperlipidemia (medical management). In each case, the indicator was modeled as a dichotomous variable—that is, every visit was identified as being eligible or ineligible for each quality indicator (1 = eligible; 0 = ineligible), and each eligible visit was classified as receiving or not receiving "recommended care" (1 = received recommended care; 0 = otherwise). The service utilization and referral pattern measures were derived from survey items detailing the procedures, treatments, and postvisit follow-up plans documented during each visit and were modeled as binary (eg, 1 = service ordered/provided or referral made; 0 = otherwise) or count variables (eg, total number of medications).

Separate regression models were constructed for each outcome and included the predictors of primary interest—that is, dichotomous variables reflecting each practitioner type (NP, PA) with PCMDs serving as the reference group—and, based on underlying theory and previous research, a multitude of covariates for statistical control. In those cases where potential correlates were not available in NAMCS or missing values limited a variable's use, suitable proxies were explored. For example, percent of the population with a high school diploma or higher based on the patient's zip code served as a proxy for patient's level of education, which was

TABLE 1. Outcomes Studied[21–26]

Outcome	Type	Description
1. Smoking cessation counse1ing)[27,28]	Binary	Numerator: Received smoking cessation intervention (i.e., nicotine replacement therapy or medications ordered, supplied, administered, or continued and/or smoking cessation counseling) Denominator: Visits by adults who were screened for tobacco use and identified as smokers
2. Depression treatment[29]	Binary	Numerator: Antidepressants ordered, supplied, administered, or continued and/or psychotherapy or mental health counseling Denominator: Visits by adults with depression
3. Statin for hyperlipidemia[30]	Binary	Numerator: Statin ordered, supplied, administered, or continued Denominator: Visits by adults with hyperlipidemia
4. Physical exam	Binary	Physical exam/general medical exam provided
5. Total number ofhealth education/counseling services	Count	All of the following services ordered/ provided during the visit: asthma, diet/nutrition, exercise, family planning/contraception, growth/ development, injury prevention, stress management, tobacco use/ exposure, and weight reduction
6. Imaging services	Binary	Any of the following services that were ordered/provided during the visit: x-ray, bone mineral density, CT scan, echocardiogram, and other ultrasound
7. Total number of medications	Count	All of the following that were ordered, supplied, administered or continued during the visit: prescription and over-the-counter drugs, immunizations, allergy shots, oxygen, anesthetics, chemotherapy, and dietary supplements
8. Return visit at a specified time	Binary	Visit disposition marked 'return at a specified time'
9. Physician (MD) referral	Binary	Visit disposition marked 'referred to other physician'

not available in NAMCS. Each variable's values were closely examined, transformations were made, and summary statistics and bivariate associations were examined to determine the strength and direction of associations. Covariates were added—in some cases, as higher power terms to satisfy nonlinearity assumptions—and their expected signs, statistical significance, contribution to overall fit, and effect on other covariates were used to diagnose specification error. Ultimately, estimates for each quality indicator controlled for age and age squared, sex, race, ethnicity, payer source, metropolitan status, region, number of chronic conditions and number of chronic conditions squared, HC type (Federally Qualified Health Center, other), percent of the population with a high school diploma or higher, and visit year. Estimates for each service utilization and referral pattern measure controlled for these same covariates with visit type (new problem, chronic problem, preventive care, presurgical/postsurgical care) substituting for the number of chronic conditions and number of chronic conditions squared variables.

Although we also considered the role of and the need for control variables that reflected state scope of practice policies, based on a separate, recent study, we found little evidence to support their inclusion.[32] Even so, we reran each model including these variables, and their addition to each model had only a minor effect on the magnitude of our estimates and no effect on their direction or statistical significance. Because nonresponse rates for race and ethnicity exceeded 10%, each model was reestimated incorporating their imputed values, which were derived by NCHS using a model-based, single, sequential regression method.[33] Finding that differences were small, all reported results include imputed values.

Adjustments for NAMCS' Complex Survey Design

As a multistage probability survey, each year's NAMCS sample was comprised of a selection of observations from the population of interest rather than a complete count. Observations in the sample were nested—that is, patient visits were drawn from selected practitioners within HCs—which resulted in greater homogeneity than if observations had been independent. Without statistical adjustments, these survey features can introduce bias and increase variance.[34] There are 2, common approaches to estimation when faced with these challenges—design-based and model-based inference.[35,36] Design-based models rely on the distribution of all possible samples that could have been chosen under the sample design. Using this approach to inference, the analyst relies on variables that describe the survey's characteristics (eg, strata and cluster identifiers, finite population correction), specifies the method of variance estimation, and uses sampling weights to "map" the sample back to an unbiased representation of the survey population. In contrast, model-based inference relies on the distribution of the random variable of interest. In these cases, the analyst fits a model, which is assumed to be true—that is, accurately and reliably accounts for the dependencies and variances—and ignores the sampling design. Model-based approaches allow the analyst to estimate individual and group effects and decompose the variance into its within-group and between-group components.

Given their relative strengths and different uses, we used both approaches, choosing a 3-level [patient (level 1), practitioner (level 2), HC (level 3)], random intercept model. Because of the constrained nature of the outcomes and their non-normal distribution, we used logistic and negative binomial models and maximum pseudolikelihood estimation techniques. Also, we relied on intraclass correlation coefficients to divide the variance components into the: (a) proportion among patients within practitioners ($\hat{\rho}_i$), (b) proportion among practitioners within HCs ($\hat{\rho}_p$), and (c) proportion among HCs ($\hat{\rho}_h$). Stata/SE 12.1 was used for design-based analyses,[37] but because of its limitations for multilevel modeling, Hierarchical Linear and Nonlinear Modeling version 7.01 was used for model-based analyses.[38]

In addition to our choice of model type, we also contemplated how to handle the sampling weights. Researchers agree on their use to produce population descriptive statistics

and when conducting inferential analyses to correct for heteroskedasticity and endogenous sampling, identify misspecification and average partial effects, and proxy for ≥ 1 feature of the sample design that has a bearing on the outcome of interest (referred to as "informative sample design").[39] We assumed NAMCS to be an informative design given its oversampling of respondents from highly populous geographic sampling units and corresponding patterns of regional variation in quality—that is, higher quality in less populous states and those in the Northeast—which have been well documented.[40–44] Even so, because our weighted and unweighted estimates differed—which was suggestive of misspecification—we double checked our assumptions with appropriate diagnostics and explored alternative covariate structures. Finding no evidence of bias, we opted to weight all estimates. (Note: unweighted estimates are available from the authors upon request.)

RESULTS

During the 5-year study period, data from 1139 practitioners were collected in the NAMCS database, a sample representing nearly 15,000 practitioners nationwide—69% PCMDs, 21% NPs, and approximately 10% PAs. In most ways, the distribution of these clinicians' characteristics was similar by practitioner type (Table 2) although a greater proportion of NPs was female compared with PCMDs or PAs (92% vs. 44% and 62%, respectively). At the same time, a larger percentage of NPs and PAs were white and worked in rural HCs than their PCMD counterparts, although sample size limitations made these results imprecise [ie, coefficients of variation (relative SEs) were >0.30]. These descriptive statistics are consistent with those most recently reported by Morgan et al[5,19] for the NAMCS HC sample over the same period.

After excluding visits to nurse midwives and those to >1 practitioner, there were 23,704 patient visits, representing nearly 30 million visits to US HCs from 2006 to 2010 (Table 2). For the most part, visits to NPs and PAs were similar to those seen by PCMDs; however, there was a 10-percentage point difference by sex—70% of visits to NPs were by female patients versus 59% and 57% to PCMDs and PAs, respectively—and by ethnicity—25% of visits to NPs, 26% of visits to PAs, and 36% of visits to PCMDs were made by Hispanic/Latino patients. Also, NPs tended to see patients who had been seen fewer times over the past 12 months than PCMDs or PAs.

Regarding the primary research question about the comparability of NP, PA, and PCMD care, in large part, there was insufficient evidence to reject the null hypothesis regardless of which approach to analysis was taken (Table 3). On 7 of the 9 outcomes studied, no statistically significant differences were detected in NP or PA care compared with PCMD care. On the remaining 2 outcomes, patients seen by NPs were more likely to receive recommended smoking cessation counseling [adjusted odds ratio (AOR) = 1.62; 95% confidence interval (CI), 1.17–2.26; $P \leq 0.01$ (design based) and AOR = 1.80; 95% CI, 1.15–2.80; $P \leq 0.05$ (model based)] and patients seen by either NPs [adjusted incidence rate ratio (aIRR) = 1.40; 95% CI, 1.19–1.64; $P \leq 0.01$ (design based) and aIRR = 1.20; 95% CI, 1.02–1.40; $P \leq 0.05$ (model based)] or PAs [aIRR = 1.28; 95% CI, 1.08–1.52; $P \leq 0.01$ (design based) and aIRR = 0.91; 95% CI, 0.61–1.46; $P = 0.50$ (model based)] received significantly more health education/counseling services than patients seen by PCMDs. Although patients seen by NPs were less likely to receive recommended depression treatment [AOR = 0.69; 95% CI, 0.46–1.03 (design based) and AOR = 0.72; 95% CI, 0.50–1.04 (model based)], these differences were not statistically significant at any conventional level.

The hierarchical linear models described the distribution of the variation within practitioner, across practitioners, and within HCs. Although the intraclass correlation coefficients were outcome dependent (Table 3), there was a large range in how the total variance was distributed. For example, the proportion of variance in the number of medications was greater within practitioners—that is, more of the variation was explained by differences among patients—than either across practitioners or HCs (ie, 0.90 vs. 0.04 and 0.06). At the same time, the proportion of variance was much more evenly distributed for recommended return visits (ie, 0.38 vs. 0.27 and 0.35). For nearly every outcome, the proportion of within-practitioner variance (ie, among patients) tended to be larger than either the across-practitioner or across-HC variation. These results suggest that more of the variation in care was attributable to differences among patients than to differences either among practitioners or among HCs.

In addition to the AORs, predictive margins—which estimate the average probability of each outcome by practitioner type while leaving all other predictors at their observed values—were estimated (Table 4). Merely as an example, in terms of smoking cessation counseling—where the adjusted odds of receiving recommended counseling was found to be higher among patients seen by NPs than among patients seen by PCMDs—the predicted probability of receiving such care from an NP was 33% compared with 26% from a PA and 24% from a PCMD (differences which were statistically different from zero at the 1% level of significance). The predicted probability of receiving a physical exam was 13% regardless of whether the patient visited an NP, PA, or PCMD (a difference that was not statistically different from zero). Across all 9 outcomes, statistically significant differences between NP or PA and PCMD care were detected on only 2 outcomes—that is, the probability of receiving smoking cessation counseling was higher when seen by an NP and patients seen by either an NP or PA received more health education/counseling services than those seen by a PCMD. In each of the other 7 cases, differences between these practitioner groups were evident but did not reach statistical significance at any conventional level.

DISCUSSION

HCs are assuming a greater role in the provision of primary care. Although these providers have historically depended on PCMDs to deliver primary care, they are shifting toward the use of NPs and PAs. Our findings, which suggest that NP, PA, and PCMD care are comparable in HCs,

TABLE 2. Sample Characteristics by Practitioner Type in Health Centers (2006–2010)*†

Practitioner Characteristic	PCMD (n = 742)	NP (n = 291)	PA (n = 106)	*P*
Age (mean) (y)	48	48	47	0.75
Sex (%)				
Female	44	92	62	<0.01
Race (%)				
White	70	88	89	
Black	12	8‡	8‡	<0.01
Other	18	4‡	3‡	
Ethnicity (%)				
Hispanic/Latino	8	6‡	10‡	0.72
Health center type (%)				
Federally Qualified Health Center	89	96	91	0.28
Metro status (%)				
Rural	11‡	28‡	32‡	<0.01
Region (%)				
Northeast	28	24	27‡	
Midwest	17	20	15‡	0.96
South	25	29	24‡	
West	31	27	34	
Patient Visit Characteristic	**PCMD (n = 15,743)**	**NP (n = 5250)**	**PA (n = 2711)**	***P***
Age (mean) (y)	35	32	36	0.42
Sex (%)				
Female	59	70	57	<0.01
Race (%)				
Black	32	30	26	0.45
Ethnicity (%)				
Hispanic/Latino	36	25	26	0.02
Payer source (%)				
Private insurance	16	17	21	
Medicare	14	8	11	0.14
Medicaid	42	40	32	
Self-pay	13	16	21	
Other	16	19	15	
Visit type (%)				
New problem	40	40	46	
Chronic problem	34	27	32	0.15
Preventive care	26	32	20	
Presurgical/postsurgical	1	1‡	1‡	
No. chronic conditions (%)				
None	45	52	46	
1	24	23	23	0.27
2–3	24	18	23	
≥ 4	6	7	8	
No. past visits over the last 12 mo (%)				
None	3	6	3	0.03
1–3	47	49	52	
4–10	42	35	38	
> 10	8	10	7	
No. medications (%)				
None	19	19	18	
1	22	28	22	0.50
2–4	35	34	37	
≥ 5	23	20	23	
Primary care shortage area designation (%)				
None of county	1‡	3‡	< 1‡	0.70
Whole county	44	46	45	
Part of county	55	52	55	
Year (%)				
2006	12	9	12	
2007	23	25	11	0.33
2008	20	16	24	
2009	28	32	22	
2010	18	28	32	

*Adjusted for complex survey design and weighted for sampling probabilities.
†Population of 14,679 practitioners and 29,848,995 visits.
‡Coefficient of variation/relative SE >0.3.
NP indicates nurse practitioner; PA, physician assistant; PCMD, primary care physician.

TABLE 3. Effect of Practitioner Type on Quality of Care and Practice Patterns in Health Centers (2006–2010)[†]

Design-Based Approach/Adjusted Odds Ratio (CI)[‡]			Model-Based Approach/Adjusted Odds Ratio (CI)[‡]		
Outcome	**NP Visit**	**PA Visit**	**Outcome**	**NP Visit**	**PA Visit**
Quality Indicator[§]			**Quality Indicator[§]**		
Smoking cessation (n=3882)	1.62** (1.17-2.26)	1.16 (0.68-1.97)	Smoking cessation (n_i=3862; n_p=735; n_h=363)‖	1.80* (1.15-2.80) $\hat{\rho}_i$=0.54 $\hat{\rho}_p$=0.12 $\hat{\rho}_h$=0.34	0.95 (0.55-2.64)
Depression treatment (n=2734)	0.69 (0.46-1.03)	1.17 (0.70-1.94)	Depression treatment (n_i=2712; n_p=678; n_h=350)‖	0.72 (0.50-1.04) $\hat{\rho}_i$=0.56 $\hat{\rho}_p$=0.22 $\hat{\rho}_h$=0.22	1.06 (0.70-1.60)
Statin for hyperlipidemia (n=2737)	0.88 (0.65-1.20)	1.03 (0.65-1.62)	Statin for hyperlipidemia (n_i=2732; n_p=654; n_h=346)‖	0.94 (0.66-1.34) $\hat{\rho}_i$=0.50 $\hat{\rho}_p$=0.31 $\hat{\rho}_h$=0.19	0.98 (0.61-1.59)
Service Utilization and Referral Pattern Measure[¶]			**Service Utilization and Referral Pattern Measure[¶]**		
Physical exam (n=21296)	0.97 (0.72-1.31)	1.01 (0.71-1.43)	Physical exam (n_i=21233; n_p=1011; n_h=399)‖	0.94 (0.70-1.27) $\hat{\rho}_i$=0.59 $\hat{\rho}_p$=0.39 $\hat{\rho}_h$=0.05	0.94 (0.61-1.46)
Health education services[#] (n=21153)	1.40** (1.19-1.64)	1.28** (1.08-1.52)	Health education services[#] (n_i=20920; n_p=1009; n_h=399)‖	1.20* (1.02-1.40) $\hat{\rho}_i$=0.54 $\hat{\rho}_p$=0.19 $\hat{\rho}_h$=0.27	0.91 (0.71-1.19)
Medications[#] (n=21466)	0.97 (0.88-1.07)	1.00 (0.91-1.10)	Medications[#] (n_i=21233; n_p=1011; n_h=399)‖	0.94 (0.86-1.03) $\hat{\rho}_i$=0.90 $\hat{\rho}_p$=0.04 $\hat{\rho}_h$=0.06	1.03 (0.92-1.15)
Imaging (n=21466)	0.94 (0.77-1.15)	1.14 (0.84-1.54)	Imaging (n_i=21233; n_p=1011; n_h=399)‖	0.90 (0.70-1.15) $\hat{\rho}_i$=0.70 $\hat{\rho}_p$=0.17 $\hat{\rho}_h$=0.13	1.16 (0.90-1.49)
Return visit (n=21466)	1.05 (0.76-1.44)	0.77 (0.52-1.13)	Return visit (n_i=21233; n_p=1011; n_h=399)‖	0.96 (0.74-1.25) $\hat{\rho}_i$=0.38 $\hat{\rho}_p$=0.27 $\hat{\rho}_h$=0.35	0.78 (0.58-1.07)
Physician referral (n=21466)	1.08 (0.87-1.35)	1.17 (0.87-1.56)	Physician referral (n_i=21233; n_p=1011; n_h=399)‖	1.05 (0.87-1.28) $\hat{\rho}_i$=0.39 $\hat{\rho}_p$=0.54 $\hat{\rho}_h$=0.06	0.97 (0.75-1.25)

$\hat{\rho}$ = intraclass correlation coefficient (ρ_i = patient visit; ρ_p = practitioner; ρ_h = health center).
*$P \leq 0.05$ (vs. PCMD).
**$P \leq 0.01$ (vs. PCMD).
[†]Adjusted for complex survey design and weighted for sampling probabilities.
[‡]CIs based on Taylor linearized SEs.
[§]Controlled for age, age^2, sex, race, ethnicity, payer, metro status (rural), region, # chronic conditions, # chronic conditions^2, health center type, % with high school diploma or higher, and year.
‖Sample size differences due to missing data within hierarchy (n_i = patient/visit; n_p = practitioner; n_h = health center).
[¶]Controlled for age, age^2, sex, race, ethnicity, payer, metro status (rural), region, reason for visit, health center type, % with high school diploma or higher, and year.
[#]Negative binomial distribution and adjusted incidence rate ratio reported.
CI indicates confidence interval; NP, nurse practitioner; PA, physician assistant.

suggest that greater use of NPs and PAs is unlikely to have a dramatic effect on patient care as specified by the 9 outcomes we examined (and may improve care in some areas). From a practice perspective, this should offer reassurance to patients who are served by HCs that NPs and PAs provide care that is largely equivalent to PCMDs. These findings should also encourage HC administrators, who depend on NPs and PAs to meet growing demands for primary care in their communities, that the quality of care will be maintained. This is especially important given the relative difficulty HCs have recruiting and retaining PCMDs compared with NPs and PAs.[45]

The study also has important policy relevance especially given federal investments in the Health Center Program and commitments to achieving the triple aim—better care, better health, and lower costs.[46] On one hand, our findings should heighten policymakers' confidence in the contributions of NPs and PAs to high-quality care and inform their decisions regarding occupational licensing and regulation, payment reform, and health professions' education. Especially because the cost of using an NP or PA is typically less than a PCMD,[47] their comparable outcomes could produce cost-savings for HCs. On the other hand, small differences in our estimates could have significant economic repercussions. For example, we found that NPs and PAs provide as much as 30%–40% more health education/counseling services than PCMDs. Although these services may benefit patients, if they are excessively costly or unnecessary, they could represent system inefficiencies and waste.

The study has several limitations. For example, the statistical analysis requires strong assumptions for the parameter estimates to be unbiased, and these assumptions may not have been met. To address potential bias and as an additional sensitivity analysis, we reestimated the effect of NP and PA care on each outcome using propensity score matching, which paired treatment units (NP visits, NP+PA visits) to comparison units (PCMD visits) that were as similar as possible on their observable characteristics. On 8 of the 9 outcomes, the direction and the statistical significance of the postmatch estimates were largely unchanged. For only 1 outcome—that is, smoking cessation counseling—were NPs more likely to provide recommended care than PCMDs, but the difference in the postmatch estimate was not statistically significant as it had been in the full sample. Despite this difference, these results suggest that our initial models adequately accounted for observable differences associated with practitioner assignment. (Note: estimates from these propensity score matched samples are available from the authors upon request.)

Patients, practitioners, policymakers, and other health care decision makers should be particularly mindful of the results presented in Table 4, which provide an overall "report card" of HC quality. On the basis of these results, patients

TABLE 4. Predicted Probability of Outcomes Studied by Practitioner Type (2006–2010)[†]

	Design-based Approach		
	Predicted Probability (CI)[‡]		
Outcome	**NP Visit**	**PA Visit**	**PCMD Visit**
Quality indicator[§]			
Smoking cessation (n = 3882)	0.33 (0.25–0.40)**	0.26 (0.16–0.36)	0.24 (0.19–0.29)
Depression treatment (n = 2734)	0.49 (0.41–0.56)	0.61 (0.50–0.72)	0.57 (0.52–0.62)
Statin for hyperlipidemia (n = 2737)	0.45 (0.37–0.54)	0.49 (0.38–0.60)	0.48 (0.41–0.56)
Service utilization and referral pattern measure[¶]			
Physical exam (n = 21,296)	0.13 (0.10–0.15)	0.13 (0.10–0.15)	0.13 (0.11–0.15)
Health education services (n = 21,153)[#]	0.96 (0.78–1.15)**	0.88 (0.73–1.03)**	0.69 (0.57–0.81)
Medications (n = 21,466)[#]	2.62 (2.25–2.99)	2.69 (2.36–3.03)	2.70 (2.44–2.95)
Imaging (n = 21,466)	0.08 (0.07–0.10)	0.10 (0.07–0.12)	0.09 (0.08–0.10)
Return visit (n = 21,466)	0.69 (0.63–0.76)	0.63 (0.55–0.71)	0.68 (0.64–0.72)
Physician referral (n = 21,466)	0.14 (0.11–0.16)	0.14 (0.11–0.18)	0.13 (0.11–0.15)

*$P \leq 0.05$ (vs. PCMD).
**$P \leq 0.01$ (vs. PCMD).
[†]Adjusted for complex survey design and weighted for sampling probabilities.
[‡]Confidence intervals adjusted for repeated sampling.
[§]Controlled for age, age^2, sex, race, ethnicity, payer, metro status (rural), region, # chronic conditions, # chronic conditions^2, health center type, % with high school diploma or higher, and year.
[¶]Controlled for age, age^2, sex, race, ethnicity, payer, metro status (rural), region, reason for visit, health center type, % with high school diploma or higher, and year.
[#]Negative binomial distribution and adjusted incidence rate ratio reported.
CI indicates confidence interval; NP, nurse practitioner; PA, physician assistant; PCMD, primary care physician.

routinely received less than one half of recommended care, with considerable outcome-to-outcome variation. These estimates are generally consistent with studies that have examined the quality of care in the United States across a range of settings and measures,[48] including studies that have relied on the NAMCS-derived quality indicators.[21–26] Taken together, findings suggest substantial gaps in the quality of HC care.

Finally, although caution should be exercised when interpreting the variance decomposition results, they suggest the presence of considerable variation in care that was better explained by differences among patients than differences across practitioners or HCs. This could signal the presence of unobservable or inadequately controlled patient characteristics. A study by Tyo et al[49] raised this same issue and argued for improved risk-adjustment methods to adequately control patient heterogeneity especially when outcomes are used for performance-based payments. At the same time, results from a study by Selby et al[50] suggest that quality improvement remains possible even when the relative proportion of variance at the practitioner level and/or facility level is small. So although statistical tools can certainly be improved, practitioners and providers should not let low proportional variance discourage them from achieving higher value nor should policymakers be deterred from incentivizing it.

CONCLUSIONS

Under the Affordable Care Act, the role of HCs will continue to expand and these providers' dependence on NPs and PAs will grow. Although evidence of the equivalence of NPs, PAs, and PCMDs has been substantiated in physician offices and hospital-based clinics, until this point, findings could not be generalized to HCs. By isolating visits made to NPs, PAs, and PCMDs and estimating the differential impact of being seen by each practitioner type on a variety of outcomes, our findings extend what is known about the equivalence of these clinicians to HCs and inform decision makers about the real-world consequences of increasing the share of NP-delivered and PA-delivered care in this setting.

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